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The PRESIDENT said the author of the paper did not tell us that he took either aneroids or other instruments with him ; and of course his heights could not be relied upon. But he must say the paper was calculated to excite public interest in the region explored, and to create a desire for proper survey of this region.

2.—*Notes on the Physical Geography of the Belize River.*

By S. COCKBURN, Esq.

[Extracts.]

As one of the Commissioners in the late expedition up the River Belize, it struck me that I might take the opportunity to make, in passing, some observations on the physical aspect of the localities we had to visit, which, though not the immediate object of the Mission, might still, I thought, prove not altogether devoid of interest. Unfortunately I took with me no instruments save a portable aneroid barometer, which, however, behaved very well, and enabled me to arrive at conclusions with tolerable accuracy, though the whole perhaps would require verification ; for, in the absence of any statistics on the subject, I had solely my own observations to rely upon : the deductions therefore are the very best approximations possible, and can only serve as a basis of comparison on any future explorations.

The maps of the country are very incorrect, but on careful admeasurements of several Spanish maps of Guatemala, &c., I make the watershed of the river 90 miles by 30, equal to 2700 square miles, and, allowing 100 inches of rain to fall over that area annually (by no means too much, for it often rains in the interior, the mountains and forests attracting the clouds, when not a drop falls here, and the average rainfall in Belize for the last four years is $67\frac{1}{2}$ inches), it will give no less than 39,128,161,745 gallons, equal to 17,467,929 tons.

I find the length of the river from Belize to the fork at the "Branch," allowing for sinuosities, to be 150 miles ; the two branches to their imaginary source, estimated at 30 miles ; the creeks, many of which are now dry, 220 miles. Then at "Orange Walk" it is 187 feet wide, and 3, 6, 9, 6, 3 feet deep at different parts across. At "Young Girl" it is 180 feet wide, and 6, 10, 6 deep. Higher up, at the "Branch," it is 100 feet broad, and 3 and 6 deep ; and lower down it is 200 feet by 8, while at the "Haulover" it is 600 by 10, and from the new road across it is 420 by 12, and at the Belize Bridge it is 121 feet from side to side, by 8, 11, 6 deep. Besides these there are some pools and basins 20 and 25 feet deep. Taking the mean of all these measurements (allowing only

100 miles \times 10 \times 12 feet for the *present* state of the tributaries with their lagoons) we have 2,007,073,600 cubic feet, equal to 12,500,289 gallons, or 55,840 tons of water *at present* in the river; deduct this from the rainfall, leaves 17,412,089 tons for the discharge and evaporation per year.

I estimate by experiments at the Belize Bridge and the Haulover that the river discharges into the sea by these two mouths about 5,413,680 tons per year, equal to 2276 gallons per minute; which deducted from the figures last quoted, leaves the large quantity of 11,998,409 tons due to evaporation. This is not improbable, since the discharge of some of the largest rivers is comparatively small in proportion to the rainfall, the greater part going off by evaporation, especially in tropical climes. The area of the Mississippi valley, for instance, is said to embrace 982,000 square miles, and the annual average rainfall equal to 40 inches, while the river discharges only about 107 cubic miles annually into the sea, equal to about one-sixth of all the rain that falls upon its watershed, leaving 513 cubic miles of water to be evaporated from this river-basin annually. Still other measurements should be taken during freshets and at the floods to verify my calculations. Indeed a series of continuous observations should be spread over a whole year in order to arrive at a correct estimate of the total annual discharge into the sea. But as I noted the marks left by the high water in different places on the banks, and on trees by the margin of the river, I have used them as a rough guide in the mean time.

The water at the floods rises in some places 25 and 35 feet in the main river, and in the creeks 10 and 20; and, though there are ridges intervening, the lands on the northern part of this hydrographic basin is much lower than the river: they must therefore be under water in the rainy season, and the strong current of the main river must push back the waters of many of the creeks, overflow the lagoons and inundate the whole country round. This must have happened even to Belize before the Haulover mouth was opened, for it appears to me that formerly the river discharged itself only by the embouchure at the Belize Bridge, where it must often, on a "top-gallant flood," have spread itself over large areas in the immediate vicinity, till the force of the current opened another mouth for itself at the estuary of the Haulover, and thus the delta was formed. Those lands are slowly rising, as much from the detritus brought down by the river as from the influence of gentle internal forces; and in the course of time even the lagoons will silt up and become dry, so that in *after ages* the whole will become a rich "bottom," covered with alluvial deposits of the most productive kind, in the

same manner as the present ridges were before they were elevated to their present height.

The banks on either side rise gradually as you go up, and the limestone formation crops out here and there, embedded in a concretion of coarse calcareous grit, with iron oxide, with thick layers of marl, loam, and clay, overtopped by the silt and detritus brought down and deposited by the river. The limestone thins out at the "Branch," where foliated slate appears, with joints and cleavage distinctly marked, rendering it well fitted for economical purposes. In some places the clay is mottled and variegated like Spanish soap, and in others (as at "Red Bank") it assumes a dark-red colour, from the abundance of ferruginous oxide. At "Hogstye," between "Red Bank" and "Orange Walk," a large block of pure gypsum crops out, and at "Duck Run" large boulders of indurated calcareous marl appear in the bed of the river.

There are some other rocks lower down at the rapids; and though, in the dry, the incline is very great and the current rapid, the channel being very narrow, and boats sometimes get upset in passing, yet there is no actual danger which care and caution will not overcome. There is nothing like a cataract or waterfall strictly so called, and I have no doubt that, by blasting the rocks and removing other impediments, a proper steamer might navigate as far as the "Branch" for at least six months in the year. At present the river is fordable in several places, and it sinks at the rate of six inches in the twenty-four hours; but one day it rose twelve inches, in consequence of rain having fallen in the interior the day before. It is heavy and brackish even up to "Bakers," where the tide I believe reaches, but improves as you go higher up; still, even at "Young Girl," though drinkable, it is copiously impregnated with lime. The temperature at any hour, night or day, is always higher than that of the air. I had no detached thermometer to test it by, but to the touch and feeling it always had a sensible degree of warmth.

The whole extent of the lands we traversed is covered with dense forests of timber (dicotyledons, coniferæ, &c.) and thick tangled underwood, vines, and jungle, in the wildest tropical luxuriance. The land is undulating, and rises in a gentle slope up to the base of the Blue Mountains of Guatemala.

The formation is undoubtedly of limestone of the tertiary period, but of a soft, coarse, and impure description. In fact, it is more a sort of calcareous breccia mixed with iron oxide, not unlike the *Calcaire Grossier* of the Paris basin, only that it contains no comminuted shells, and so *very recent*—nay modern, geologically speaking, as hardly to have yet acquired a consistency beyond indurated

calcareous marl. This applies especially to the portions projecting through the alluvium in the ridges, where they are granular and friable. Fragments of fossil shell (*volutæ*), with their casts, I dug up on the ridge at "Young Girl." Their analogues are to be found in existing species in the neighbouring sea, thus proving how very recent the formation is. To me it seems even posterior to the *pleistocene* of the tertiary.

Belize, 30th June, 1867.

The PRESIDENT said that some of the observations contained in this account of the basin of the river Belize were of geological interest, as they related to the amount of mud and clay brought down by the river, and the gradual elevation of the coast. The statistics of the volume of water which the author had given were also worthy of notice. Respecting the river Belize, Admiral Collinson had informed him that Lieutenant Cooper Abbs, R.N., of the *Doris* frigate, had recently explored a great part of the district, and had sent home a report of his investigations with a detailed map. He was happy to announce that the valuable geographical observations contained in this report were being extracted by Admiral Collinson, and that a memoir would shortly be laid before the Society.

Fifth Meeting, January 27th, 1868.

ADMIRAL SIR GEORGE BACK, D.C.L., F.R.S., VICE-PRESIDENT, in the Chair.

ELECTIONS.—*Joseph Anderson, Esq.; John Anderson, Esq.; G. F. Angas, Esq.; Capt. H. Barber; W. E. Blair, Esq.; Richard Davis, Esq.; Capt. F. J. A. Dunn; C. F. Ellis, Esq., Lieut. R.A.; William Falconer, Esq.; A. Fyfe, Esq., M.D.; A. Gilliat, Esq.; J. Percival Hunt, Esq., M.D.; Richard Jamieson, Esq.; A. Laybourn, Esq.; Henry Murray, Esq.; F. McClean, Esq.; B. Newbatt, Esq., M.A., &c.; D. Phillips, Esq.; Trevor Plowden, Esq.; Charles S. Price, Esq.; H. C. Rass-Johnson, Esq.; Capt. G. E. Shelley; Alexander W. T. G. Thorold, Esq.; W. Walkinshaw, Esq.; F. M. Williams, Esq., M.P.*

ACCESSIONS TO THE LIBRARY from JANUARY 13TH to 27TH 1868:—
 'The Treasury of Geography: Physical, Historical, Descriptive, and Political,' &c., by W. Hughes, F.R.G.S., 1867. 'The Geography of British History; a Geographical description of the British Islands,' &c., by W. Hughes, 1866. 'A Manual of Geography, Physical, Industrial, and Political,' by W. Hughes, F.R.G.S., 1867. The latest editions of W. Hughes' Geographical Works, presented by the Author. 'The Chinese Miscellany, designed to illustrate the Government Philosophy, &c., of China,' Shanghai, 1849.